

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the Claims

Please cancel claims 1-20.

Please add the following new claims.

5 ✓ 21. (New) A method of forming a contact plug, comprising the steps of:

selectively making a hole in an insulating layer that has a top surface, a side-wall surface being thereby formed in said insulating layer to define said hole;

AB  
10 forming a barrier layer on said insulating layer such that a first portion of said barrier layer on said top surface of said insulating layer is greater in thickness than a second portion of said barrier on said side-wall surface of said insulating layer, said second portion of said barrier layer defining a space corresponding to said hole;

15 depositing a conductive layer over said first and second portions of said barrier layer while filling said space;

20 etching back said conductive layer until said first portion of said barrier layer is exposed to thereby form a plug portion that fills said space and has a top surface which projects above said top surface of said insulating layer; and

removing said first portion of said barrier layer until said top surface of said insulating layer is exposed to thereby form a contact plug that fills said space and has a top surface which projects above said top surface of said insulating layer.

25 ✓ 22. (New) The method as claimed in claim 21, wherein said barrier layer comprises a first metal film and said first metal film is formed by anisotropic sputtering.

30 ✓ 23. (New) The method as claimed in claim 22, wherein said first metal film comprises titanium.

✓ 24. (New) The method as claimed in claim 22, wherein said anisotropic sputtering is performed in an ion metal plasma sputtering manner.

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5 25. (New) The method as claimed in claim 26, wherein said anisotropic sputtering is performed  
in a collimate sputtering manner.

6 26. (New) The method as claimed in claim 22, wherein said anisotropic sputtering is performed  
5 in a long throw sputtering manner.

7 27. (New) The method as claimed in claim 22, wherein said barrier layer further comprises a  
second metal film that is formed on said first metal film by an isotropic sputtering.

8 28. (New) The method as claimed in claim 27, wherein said first metal film comprises titanium  
and said second metal layer comprises titanium nitride.

9 29. (New) The method as claimed in claim 27, wherein said anisotropic sputtering is performed  
in an ion metal plasma sputtering manner.

10 30. (New) The method as claimed in claim 27, wherein said anisotropic sputtering is performed  
in a collimate sputtering manner.

11 31. (New) The method as claimed in claim 27, wherein said anisotropic sputtering is performed  
20 in a long throw sputtering manner.

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12  
32. (New) A method of forming a contact hole, comprising the steps of:

etching through a first insulating film to form a contact hole therein;

depositing a first conductive film on the first insulating layer and a side inner surface of the contact hole;

5 depositing a second conductive film on the first conductive film;

depositing a third conductive film that fills the contact hole; and

etching to expose the first insulating film around the contact hole and form a plug from the third conductive film that extends above a top surface of the first insulating film.

13  
33. (New) The method of claim 32, wherein

the first conductive film comprises titanium; and

the second conductive film comprises titanium nitride.

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34. (New) The method of claim 32, wherein

the third conductive film comprises tungsten.

15  
35. (New) The method of claim 32, wherein

the step of etching includes

20 etching the third conductive film to a level below the first conductive film and above the first insulating film, and

etching the first and second conductive films to expose the top surface of the first insulating film.

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16 36. (New) A method, comprising the steps of:

depositing first conductive film over a first insulating layer having a hole formed therein, the first conductive film being thicker over a top surface of the first insulating layer than on a side surface of the hole;

5 depositing a second conductive film over the first conductive film;

depositing a third conductive film over the second conductive film and within the hole; and

10 etching the third conductive film selective to the second conductive film to expose the second conductive film around the hole, the third conductive film being only within the hole and having a plug top that extends above the top surface of the first insulating layer but below a top surface of the second conductive film.

17 37. (New) The method of claim 36, further including:

15 selectively etching the first and second conductive films relative to the third conductive film to form expose the top surface of the first insulating film around the hole, the first and second conductive films being only within the hole.

18 38. (New) The method of claim 36, wherein

20 the hole is less than 0.3 microns wide.

19 39. (New) The method of claim 38, wherein

the hole is less than 0.25 microns wide.

25 40. (New) The method of claim 36, wherein

16 the step depositing the first conductive film is with an anisotropic method selected from the group consisting of ion metal plasma sputtering, collimate sputtering, and long throw sputtering.